MINERALS FROM THE MURRAY RIVER REGION WEST OF WENTWORTH, N.S.W., AUSTRALIA

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The geological nature of this region (Gill, this *Memoir*) is such that only a limited number of mineral species are found. The following have been identified:

Calcite is widespread in the form of calcrete, and has also been found as accretions in sandy clay beds. It is also the main constituent of lenses of ostracodal limestone.

Dolomite occurs as a soft bedded sedimentary rock, and some ostracod bands are composed of this mineral.

Gypsum is common, mainly as masses of selenite and smaller accretions in clay beds.

Manganese and iron oxides are ubiquitous, the former as stains and dendritic growths, particularly in the carbonates.

Clay minerals are represented chiefly by kaolinite and montmorillonite.

Quartz is ubiquitous, forming the main constituent of various sandy beds, and occurring as inclusions in the calcretes, and as a constituent of the clay sediments.

Opaline silica is widespread, and is described elsewhere (Segnit, Jones and Anderson, this *Memoir*).

Halite commonly occurs as efflorescences on the surfaces of soil components.

The following is a brief description of the more interesting occurrences of some of these minerals.

1. Calcite

Calcite is very widespread, particularly in the form of calcrete or kunkar, but is also found as agglomeratic or concretion-aggregates in some of the sediments.

(a) *Calcrete nodules*

These occur in the soil in very large quantities over most of the terrain (Gill, this *Memoir*), either separate, or cemented into hard bands. They consist mainly of calcite, enclosing appreciable amounts of detrital quartz.

The internal structure consists of a central core which is commonly about half the diameter of the nodule (Pl. 25, figs. 1-2), but may be greater. This is coated with successive thin layers of calcite, usually stained brown by small amounts of iron oxides. The core is also usually light brown in colour, although it may contain dark brown to black spots of iron or manganese oxides. It is generally compact (Pl. 25, fig. 1), but in some cases numerous pores are present (Pl. 25, fig. 2). Quartz grains of fine sand size show evidence of rounding; these are plentiful in the cores. The calcite of the cores has a crystallite size of the order of 2 μm but particularly around the quartz grains it is much coarser, of the order of 40-50 μm.

Around the core, deposition of calcite has built up a series of irregular concentric spheres, often enclosing small quartz particles in the process of growth. The crystallite size of the calcite in the rings is usually very small (1-2 μm), although some rings may be coarser (10-20 μm). Iron and manganese oxides are irregularly distributed through these parts of the nodules.

Rarely, weathered micaceous relics, heavy mineral particles such as apatite, and opal particles (possibly plant silica) can be identified.

(b) *Calcite accretions*

Irregular white accretions of calcite were found weathering out of the lower levels of the mottled sand intercalated low in the Blanchetown Clay about 0·5 km downstream from Devil's Elbow, Nampoo Station. Typical examples of these are shown in Pl. 25.

They are composed of white, finely crystallized calcite which forms aggregates of radiating

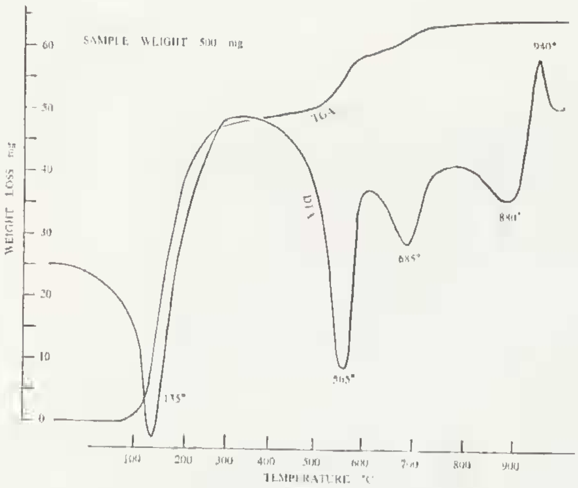

Fig. 1—Differential thermal analysis curve of Blanchetown Clay from cliffs W. of Nampoo Station homestead.

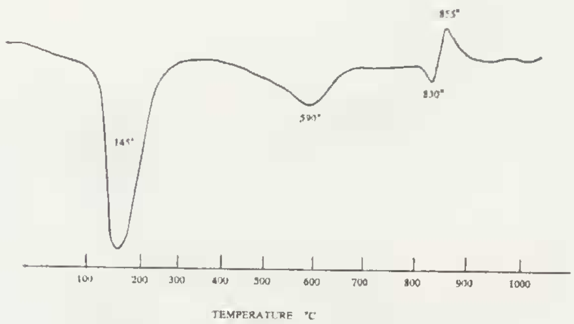

Fig. 2—Diffferential thermal and thermogravimetric analysis curves of sodium montmorillonite from Sharp Point (Devil's Elobw), Nampoo Station.

sheaves of crystallites. They enclose abundant quartz particles in the sand size range of 0·3-0·4 mm. The sheaves of calcite are also quite small, being of the order of 0·5-1 mm in length. The calcite appears to have nucleated on the quartz grains, which generally have a corona of coarser carbonate about 0·05-0·1 mm wide. The quartz grains are frequently cracked; the cracks are filled with calcite, the growth of which has often separated the broken parts of the quartz grains.

2. Dolomite

(a) *Sedimentary (precipitated) dolomite*

The bedded dolomite such as that found at Triple Swamp, Moorna Station, is a very fine-grained, white porous material. It has a very uniform microstructure of dolomite crystallites of the order of 1 μm in size. Black dendritic patches of oxide mineral (see below) a few mm in size are present in much of the dolomite rock, as well as occasional quartz grains.

This appears to be a chemically precipitated dolomite similar to material which is being deposited along the Coorong in S. Australia today (Alderman 1959, 1965, von der Borch 1965).

(b) *Metasomatic dolomite*

Some samples of ostracodal rock, either hard or relatively unconsolidated, are composed of dolomite with no detectable calcite or aragonite. The band containing ostracods from the base of the Blanchetown Clay, west of Bone Gulch, Moorna Station, N.S.W., appears rather similar to the precipitated dolomite; it is unlikely, however, that the ostracod tests were originally dolomite, as when they are found associated with sand or clay they are composed of calcite. It seems probable that the original calcite tests of the ostracods underwent metasomatic replacement by magnesium, either from magnesium solutions at the time of precipitation of the dolomite, or by later replacement in contact with the dolomite after deposition.

3. Gypsum

Gypsum occurs commonly in the Blanchetown Clay. It may be found as large nodules or accretions 25 cm or more in diameter, often with a central core of selenite. Small aggregations, several cm in diameter, are frequently found on exposed erosion surfaces of the clay beds.

4. Manganese Oxides

Manganese oxides occur mainly as dendritic growths in other rocks and minerals. Patches several mm in diameter commonly spot the dolomite at Triple Swamp. Sands from cliffs on Moorna Station north of the homestead contain many grains with black coatings. Chemical tests on these materials confirm the presence of manganese. Black dendritic growths of what is probably manganese oxide are also found at times in the calcrete nodules.

X-ray diffraction examination of the manganese oxide from the dolomite showed only the presence of dolomite itself, and traces of kaolinite and halite, indicating that the manganese oxide is in an amorphous form.

5. Clay Minerals

(a) *Montmorillonite*

The clay forming the massive Blanchetown Clay at Nampoo Station shrinks strongly and cracks to a crumbly aggregate of fragments an 2-3 cm or so in diameter on exposure to the atmosphere and drying. It is of a greenish-grey colour.

X-ray diffraction analysis of the original clay and the glycerol saturated material indicate that it is essentially a poorly organized montmorillonitic type of material containing a considerable amount of quartz. The differential thermal analysis curve is given in Fig. 1. It is characteristic of a montmorillonite-type mineral, although the higher temperature endotherms and exotherm occur at somewhat lower temperatures than usual.

(b) *Sodium montmorillonite*

A layer about 10-15 mm thick of a soft but brittle white material with the appearance of an opaque gel occurred at the base of the lower dolomite bed at Sharp Point (Devil's Elbow) on Nampoo Station. X-ray diffraction examination indicated that the material was a rather poorly crystallized montmorillonite-type material.

The sample had a loss of 19·0% water at 110°C, and an additional loss after firing of 11·0%. After evaporation with hydrofluoric and sulphuric acids, the silica content was found to be 74·9%. X-ray diffraction analysis of the residue from this evaporation showed the presence of corundum and spinel, showing that the original mineral contained alumina and magnesia. Transparent tabular crystals which formed on the upper part of the crucible used for the evaporation were identified as beta-alumina ($Na_2O.11Al_2O_3$), proving the presence of sodium.

Differential thermal and thermogravimetric curves of this mineral are given in Fig. 2. The strong endotherms at 140°C and in the 500°-700°C region, together with the exotherm at 940°C are consistent with the identification of the mineral as a sodium montmorillonite.

(c) *Kaolinite*

The white band above the clay between the Parilla and Chowilla Sands on Kulcurna was a fairly pure kaolinite containing about 10% quartz. Its X-ray diffraction pattern indicated that it was poorly crystallized material.

Kaolinite was also encountered mixed with other minerals. It was, for example, a minor constituent of some of the precipitated dolomite sediments, and in the form of methalloysite it formed part of the opal claystone from Kulcurna Station, on the hill behind the homestead.

Addendum

Further Minerals from the Murray River Region

Kaolinite

A rather pure, white kaolinite with a compact brittle character was formed as layers and lenses one to two cm thick in a friable sandstone in the cliffs at the S. end of the Euston Weir, Robinvale. X-ray examination showed that the material was a structurally well-ordered kaolinite; the crystallite size, as determined by microscopic examination, was of the order of 0·5-1 μm.

Sepiolite

An irregular fragment (approximately 15 cm diameter) of a very low density material associated with a little opal-A was found in the detritus at the foot of the cliff at Devil's Elbow, Nampoo Station. Fragments floated in water until they became saturated, and did not disintegrate.

X-ray diffraction and DTA (Fig. 3) showed the material to be sepiolite. The ignited residue after evaporation with hydrofluoric and sulphuric acids consisted of spinel and magnesium oxide, confirming the presence of much magnesium, and indicating the presence of aluminimum. Its composition may be similar to an aluminous sepiolite from South Australia (Rogers, Quirk and Norrish 1956).

It seems probable that the sepiolite formed as a gel-like material at the same time as the opal, and was possibly contemporancous with the dolomite.

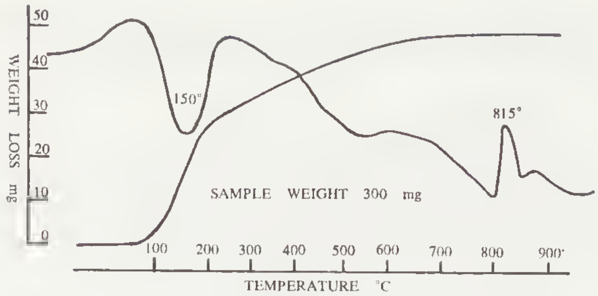

Figure 3

BARITE

Irregular nodular concretions up to 10 cm long of a very finely crystalline barite were sparsely distributed in one section of the Blanchetown Clay between the upper (dolomitic) and lower (ferruginous) parts of the basal horizon. The barite had been precipitated as a very fine-grained mud-like material; the outer surfaces of the nodules frequently showed networks of drying or shrinkage cracks. Internally, the concretions consisted of small nodules, several mm in diameter, of very fine grained barite (particle size 1-2 μm), cemented by more coarsely crystalline barite (5-10 μm).

CELESTITE

A nodule or 'bun' of celestite was found some 100 m downstream from Devil's Elbow. It appeared to have weathered out of Blanchetown Clay along with more abundant gypsum. The celestite crystals were up to 2-3 mm in length, arranged across bands, giving the impression of having (at least in part) crystallized across cracks in the clay.

References

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Explanation of Plates

PLATE 26

Figs. 1-2—Sections through centres of calcrete nodules from top of Fisherman's Cliff, Moorna Station. Diameter of nodules approximately 1·5 cm.

1. Nodule with dense core containing spots of iron and manganese oxides.
2. Nodules showing pores in core.

Photos: A. L. Lee

PLATE 27

Calcite accretions from clayey sand, near Sharp Point (Devil's Elbow), Nampoo Station. Photo: A. L. Lee.